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ABSTRACT

This paper describes the equity component of an ongoing mathematics and technology inservice program which aims to create awareness of equity issues and develop strategies essential to achieving equity. Equity interventions are briefly reviewed. Research evidence suggests that social and experiential factors help determine participation in mathematics, which is linked to achievement. Affective factors seem to be major contributors to gender difference in both achievement and enrollment in mathematics. Modifiable variables are noted, and successful programs named. A theoretical model for equity training is presented, with the equity component discussed in detail. (MNS)

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EQUITY ISSUES IN THE USE OF TECHNOLOGY IN TEACHING MATHEMATICS

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INTRODUCTION

Technology has the potential, as yet not fully realized, to have a great impact on the teaching of mathematics. That impact will affect not only what we teach in mathematics, but how we teach mathematics (Fey, 1984). The ultimate goal of any changes in the teaching of mathematics should be to improve the mathematical education of young people in our society. No discussion of mathematics education can be complete without due consideration being given to issues of equity.

Equity issues in mathematics education and equity issues in computer education have a great deal of overlap. Using computers in the teaching of mathematics may either compound the problems of inequity or reduce them. However, the latter will not occur unless educators are aware of equity issues and take appropriate actions to ensure equity. This paper describes an equity component of an ongoing mathematics and technology inservice program which aims to create the awareness and develop action-oriented strategies essential to achieving equity.

BRIEF REVIEW OF EQUITY INTERVENTIONS

Equity concerns in mathematics have focused on two main areas: participation, both in the study of mathematics and in mathematics-related careers; and achievement in mathematics. Extensive research has been conducted, especially in the last 15 years , to ascertain the extent of differential participation and achievement based on gender, and to identify reasons for identified differences. Much less research has focused on the under-representation and lower achievement of ethnic minority students. Evidence from research suggests that social and experiential factors help determine participation in mathematics, which is linked to achievement. Student attitudes, self-perceptions, and feelings about mathematics seem to be major contributors to gender differences in both achievement and enrollment in mathematics. A great deal more research is needed before we can make definitive statements with regard to minority students (see the special issue of the the Journal for Research in Mathematics Education regarding minorities and mathematics, Volume 15, Number 2 (March 1984). However, it is clear that Hispanic, Black, and Native American students are severely under-represented in the study of mathematics and in mathematics-related fields.

Modifiable variables that have been identified as related to participation and/or achievement in mathematics have formed the main targets of intervention programs: attitudes toward mathematics (especially confidence and anxiety); perception of the usefulness of mathematics; career awareness; stereotyping of mathematics as a (white) male domain; spatial visualization; encouragement to pursue mathematics; and role models. A review of content and the impact of such programs is beyond this paper; see Becker (in press) or Stage, Kreinberg, Eccles and Becker

(1985). Successful programs have included curriculum materials, such as Math for Girls (Downie, Slesnick & Stenmark, 1980) and Solving Problems of Access to Careers in Engineering and Science (SPACES) (Fraser, 1982); conferences and lecture programs, such as Expanding Your Horizons (Koltnow, 1979), Women and Mathematics, and Blacks and Mathematics; and teacher education programs, such as Teacher Education and Mathematics (Chapline, Newman, Denker and Tittle, 1981), EQUALS (Kaseberg, Kreinberg & Downie, 1980), Multiplying Options and Subtracting Bias (Fennema, Becker, Wolleat & Pedro, 1980) or NCTM's equity conferences (Cheek, 1984). Many of the ideas, approaches, and materials in these model programs were adapted in the experimental equity component described below.

THEORETICAL MODEL FOR EQUITY TRAINING

The equity training is based on a theoretical model which assumes that positive action can be stimulated by a combination of personal and social factors. In this model, awareness of equity issues should lead to action, whose results should increase feelings of personal effectiveness. Sharing experiences and results with colleagues provides both group support and increased awareness of equity issues as other perspectives are discussed. The training aims to initiate the cycle shown below in Figure 1; the establishment of a network among participants will serve to continue the cycle.

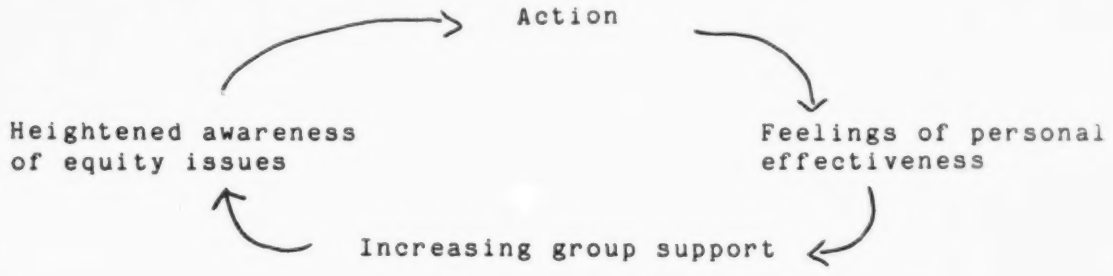

Figure 1

DESCRIPTION OF EQUITY COMPONENT

One aspect of the equity component was to clarify what we as a group mean by equity. After much discussion of the differences between equity and equal opportunity, the group came to agreement on the following characteristics of equity:

- each person develops to his/her capability regardless of sex, race, class, age, or disability;
- less differentiation exists in society in education,

careers, achievement, and roles based on the categories above;

- unrestricted expectations occur in school and society among parents, teachers, students;

- segregation in education and society caused by stereotyping ceases to exist;

- all students receive a broad exposure to a variety of possibilities for their futures, with everyone able to acquire the most valued characteristics and skills;

- members of the less dominant groups achieve parity with members of the dominant group.

From a shared sense of equity we spent considerable time identifying equity issues related to use of computers. Some of these issues originated from the author, and were reinforced by available data. For example, data were shared concerning micro ownership and use by race and socio-economic class (Center for Social Organization of Schools, 1983-4), and computer course enrollment in California to substantiate the issues of access to computers and enrollment in computer courses. Other issues came from the teachers, based on some suggested readings (e.g., The Computing Teacher special issue on equity, April 1984), or their own experiences. All of these issues were categorized into five main areas, with specific factors listed below:

I. Impact of family, school, community and society on student attitudes and expectations for themselves based on sex, race, class, disability.

Parental attitudes and expectations	Teacher support and encouragement
Student, teacher attitudes	Career aspirations
Peer influences	Legislative initiatives
Community influences	Public relations

II. Access to computers.

Enrollment in courses	Tracking
Physical location and environs	Financing
Avoidance behavior	Priorities
Bilingualism	Control

III. Use of computers.

Quality of use	Software
Teacher training	Infusion of computers
Administrative support	Control
Mathematization of computing	Competitive vs. cooperative

IV. Psychological/biological factors.

Fear of machines	Biological factors
Cognitive differences	Age
Learning styles	

V. Computers identified as male.

Male-oriented advertising
Software
Identification with
mathematics
Role models

We discussed the duality of some of these factors. For example, the mathematization of computing may work negatively, in that students already negative toward mathematics may transfer that feeling directly to computers. However, interest in computers could be used to motivate mathematical competence by showing how important mathematics is to using computers effectively.

In a follow-up session to the activities discussed above to raise awareness, we conducted a brainstorming session in groups centered around the broad categories identified as equity concerns. In these groups, teachers listed strategies or approaches which could be used to target each broad issue or sub-issue. These strategies are too numerable to list here; teachers identified over 50 strategies ranging from changing the image of the computer room by making it more conducive to group work, to structuring problem situations which can be solved by any learning style, albeit in different ways. The variety of strategies identified indirectly attest to the sophistication of awareness of equity issues by the teachers.

For the final activity of the four-week summer session, teachers were asked to identify the equity issue(s) they planned to address during the coming school year, the target group(s), the strategies they could use, and what kind of information/ resources they would need. These equity issues of focus were compiled and shared with the group, so participants knew who was interested in a similar issue to increase group support. Thirty-one teachers chose 14 issues, with the largest number choosing equal access to computers and student attitudes/ expectations.

At a Saturday session during the school year the author provided materials, articles, and resources which were specific to the issue identified by each teacher. Participants also were asked to collect some data from their schools as a means of further increasing individual and group awareness of equity issues. For secondary schools, teachers were asked to collect data on mathematics and computer course enrollment broken down by gender and ethnicity. For lower grades, teachers were asked to gather data concerning career awareness. For example, one middle

school teacher asked students to "Imagine you are 30 years old. Describe a typical Wednesday in your life. Please include activities that you do in your work, at home, and for relaxation/fun. Be as thorough as possible." Responses were compiled by gender and ethnicity and grouped into work catagories (Cheek, 1984). The most sex-typed careers from this teacher's classes were athlete (male), police/military/fire fighter (male), teacher (female), nurse (female), secretary (female), unpaid worker (female). Unfortunately, only five schools have returned data so far, so generalizations are difficult to make.

At another Saturday session, teachers were grouped with others who had chosen similar issues to target, and were asked to share experiences, especially successes. Some of these successes then were shared with the whole group. A second activity that day involved the teachers in examining mathematics vignettes (Fennema, et al., 1980) to determine whether stereotyping occurred and to suggest alternate ways to handle classroom situations. The purpose of this activity was to have teachers reflect on their own classroom behavior and ways to make it more equitable.

FORMATIVE EVALUATION OF EQUITY COMPONENT

In this first year of implementation, the equity component seems to have been successful in increasing awareness of equity issues but less successful at inducing action regarding equity. The latter is judged by the meager response to a request for data collection, no reports of teacher-initiated activities related to equity, and no requests for additional materials or use of available videotapes from the author. Equity seems to have played a low priority role in participants' activities related to the inservice program. In the next year, ways will be sought to integrate equity concerns more fully into the inservice program on mathematics through computers, and to allow more follow-up time during the school year to ensure that equity becomes a concern uppermost in the minds of all participants.

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